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ANSWER BOOK

TO ACCOMPANY

MARCH AND WOLFF'S CALCULUS

BY
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AND
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Page 11, §12

1. (*a*) $y = 2(x-2)^2$; $y = 2(x+3)^2$; $y = 2x^2 + 5$; $y = 2x^2 - 1$; $y = 2(x+2)^2 - 1$.

(*b*) $y = -3(x-2)^2$; $y = -3(x+3)^2$; $y = -3x^2 + 5$; $y = -3x^2 - 1$; $y = -3(x+2)^2 - 1$.

(*c*) $y = \log(x-2)$; $y = \log(x+3)$; $y = \log x + 5$; $y = \log x - 1$; $y = \log(x+2) - 1$.

(*d*) $y = e^{-x+2}$; $y = e^{-x-3}$; $y = e^{-x} + 5$; $y = e^{-x} - 1$; $y = e^{-x-2} - 1$.

2. (*a*) $y = 2x^2 + \frac{1}{2}x$; $y = 2x^2 - \frac{1}{2}x$; $y = 2x^2 + x$; $y = 2x^2 - x$.

(*b*) $y = -3x^2 + \frac{1}{2}x$; $y = -3x^2 - \frac{1}{2}x$; $y = -3x^2 + x$; $y = -3x^2 - x$.

(*c*) $y = \log x + \frac{1}{2}x$; $y = \log x - \frac{1}{2}x$; $y = \log x + x$; $y = \log x - x$.

(*d*) $y = e^{-x} + \frac{1}{2}x$; $y = e^{-x} - \frac{1}{2}x$; $y = e^{-x} + x$; $y = e^{-x} - x$.

3. (*a*) $y = -2x^2$; $y = 2x^2$; $x = 2y^2$; $x = -2y^2$.

(*b*) $y = 3x^2$; $y = -3x^2$; $x = -3y^2$; $x = 3y^2$.

(*c*) $y = \log\frac{1}{x}$; $y = \log(-x)$; $x = \log y$; $x = -\log(-y)$.

(*d*) $y = -e^{-x}$; $y = e^x$; $x = e^{-y}$; $x = -e^y$.

4. (*a*) $\rho = a\sin\left(\theta - \frac{\pi}{3}\right)$; $\rho = a\sin\left(\theta - \frac{\pi}{6}\right)$; $\rho = -a\cos\theta$; $\rho = -a\sin\theta$; $\rho = a\cos\theta$.

(*b*) $\rho = a\cos\left(\theta - \frac{\pi}{3}\right)$; $\rho = a\cos\left(\theta - \frac{\pi}{6}\right)$; $\rho = a\sin\theta$; $\rho = -a\cos\theta$; $\rho = -a\sin\theta$.

6. (*a*) $2xy = a^2$; (*b*) $2xy = -a^2$; (*c*) $y^2 - x^2 = a^2$; (*d*) $y^2 - x^2 = a^2$; (*e*) $x^2 + y^2 = a$.

Page 26, §20

9. $\dfrac{1}{2\sqrt{x-2}}$.

10. $\dfrac{x}{\sqrt{x^2-4}}$.

104

QA 303 .M3 1917 Answer book

Page 39, §30

1. 0.27 of 1 square inch per second.
2. 1.56 square inches per minute.
3. 0.0051 of 1 inch per minute; 0.8 of 1 square inch per minute.

Page 42, §32

12. $14x(5 - 2x^2)^{-\frac{3}{2}}$
15. $-\frac{14}{3}x(x^2 + 1)^{-\frac{4}{3}}$.
17. $-8x(x^2 + 4)^{-3}$.
18. $18x^2(5 - x^3)^{-3}$.

Page 46, §36

3. $-\frac{3x}{4y}$.
4. $\frac{x}{y}$.
5. $-\frac{b^2}{a^2}\frac{x}{y}$.
6. $-\left(\frac{y}{x}\right)^{\frac{1}{3}}$.
7. $-\left(\frac{y}{x}\right)^{\frac{1}{2}}$.
8. $-\left(\frac{x}{y}\right)^{2}$.
9. $-\left(\frac{x}{y}\right)^{\frac{1}{2}}$.

Page 51, §37

39. $-\frac{1}{3}(4 - 3x^2)^{\frac{1}{2}} + C$.
41. $-\frac{2}{15}(4 - 3x)^{\frac{5}{2}} + C$.
42. $\frac{2}{9}(x^3 + 3x - 7)^{\frac{3}{2}} + C$.
45. $\frac{1}{2}(6 + 4x - 10x^2)^{\frac{1}{2}} + C$.
48. $-\frac{1}{8}(2 - x^2)^4 + C$.
49. $3y = x^3 + 1$.
50. $3y = 2x^{\frac{3}{2}} + 4(3 - \sqrt{2})$.
51. $xy = 1$.

Page 55, §38

1. 1610 feet. 2. 1710 feet; 332 feet per second.
3. 257.6 feet down; 966 feet below the starting point; 1094.8 feet.
4. (1°) $v = t^2$; $s = \frac{1}{3}t^3$.
   (2°) $v = t^2 - 2$; $s = \frac{1}{3}t^3 - 2t + 3$.

Page 58, §40

9. $\frac{2x^2 + x - 2}{\sqrt{x^2 - 2}}$.
10. $\frac{12 + 4x - 5x^2}{3(x^2 - 4)^{\frac{2}{3}}}$.
11. $\frac{8 - 3x - 4x^2}{\sqrt{4 - x^2}}$.
12. $\frac{1 - 2x^2}{\sqrt{1 - x^2}}$.
13. $\frac{dy}{dx} = \frac{3(1 + x^2y^3)}{7 - 3x^3y^2}$.
14. $\frac{dy}{dx} = \frac{y(2x - 3y)}{x(6y - x)}$.
15. $\frac{dy}{dx} = -\frac{2y\sqrt{x} + y\sqrt{y}}{2x\sqrt{y} + x\sqrt{x}}$.
16. $\frac{dy}{dx} = \frac{y(2x - 1)}{x(1 - x)}$.

Page 59, §41

1. $\frac{-2}{(x - 1)^2}$.
2. $\frac{(x - 3)(x - 1)}{(x - 2)^2}$.
3. $\frac{1 + 2x - x^2}{(1 - x)^2}$.

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4. $\dfrac{3-x}{2(1+x)^2\sqrt{x-1}}$. **5.** $\dfrac{3x^2+1}{2x^{\frac{3}{2}}}$. **6.** $\dfrac{2+x}{2(1-x)^{\frac{5}{2}}}$.

7. $\dfrac{x+\sqrt{x^2-1}}{\sqrt{x^2-1}}$. **8.** $\dfrac{x^2-4x-4}{(x-2)^2}$. **9.** $\dfrac{2(x^3-3x^2-4)}{(x-2)^2}$.

Page 60, §42

7. $\dfrac{-12x}{(x^2+1)^2}$. **8.** $-7x(x^2+1)^{-\frac{3}{2}}$. **9.** $x(1-x^2)^{-\frac{3}{2}}$.

Page 62, §63

Ex.	Increasing when	Decreasing when	Maximum value	Minimum value
1.	$x > 0$	$x < 0$	.....	0
2.	$x < 0$ and $x > 0$			
3.	$x < 0$	$x > 0$	0	
4.	For all values of x			
5.	$x < 0$ and $x > \frac{4}{9}$	$0 < x < \frac{4}{9}$	-6	$-6\frac{32}{243}$
6.	$x > \frac{1}{2}$	$x < \frac{1}{2}$	.....	$-\frac{25}{4}$
7.	$x < 1$ and $x > 2$	$1 < x < 2$	-5	-6
8.	$x < 1$ and $x > 1$	$-1 < x < 1$	9	5
9.	$x < -1$ and $x > \frac{1}{3}$	$-1 < x < \frac{1}{3}$	0	$-\frac{32}{27}$
10.	$x < 0$	$x > 0$		

11. 4 inches. **12.** 2.4 feet by 5 feet.

13. When $t = 4$; Approaching at the rate of 5 miles per hour; Separating at the rate of 7.905 miles per hour.

14. 6 inches by $6\sqrt{3}$ inches.

Page 63, §63

17. $(x-1)(3x-1)$. **18.** $x(2-3x)$. **19.** $(1-x^2)^2(1-7x^2)$.

20. $2(1-x^3)(x-2)(1+6x^2-4x^3)$.

21. $\dfrac{1+2x-x^2}{(x^2+1)^2}$. **22.** $\dfrac{x^2-2x-1}{(1+x^2)^2}$. **23.** $\frac{1}{3}(x-1)^{-\frac{2}{3}}$.

24. $\dfrac{a^2}{(a^2-x^2)^{\frac{3}{2}}}$. **25.** $\dfrac{1-2x^2}{\sqrt{1-x^2}}$. **39.** $\frac{1}{2}(1-x^2)^{-1}+C$.

40. $-\frac{1}{2}(2x-x^2)^{-1}+C$. **43.** $-2\sqrt{1-x}+C$. **46.** $\dfrac{x}{y}$.

47. $-\dfrac{9x}{16y}$. **48.** $\frac{2}{3}\sqrt{3}$ feet per second.

49. 0; 0.201; 2.27; ∞.
50. 18.08.
51. $x = 14.14$; angle $= 45°$.
52. $-gt \cot 20° = -88.4t$.
53. 0; -494.3; -695.
54. 18.32.
55. 12.53; 13.96; $\frac{8}{13}$ of one hour.
56. 9; 27.58; when $t = 1.484$.
57. 38.43.
58. 500.
59. 249.5.
60. -840.
61. 2π; 54; 2.16.
62. 11.33; 15.1; 2.86; 153.7.

Page 67, §45

1. (*a*) $\dfrac{3u}{\sqrt{u^2+7}}$. (*b*) $2(6u^2+5)(x-1)$. (*c*) $-\dfrac{2xu}{(u^2-5)^{\frac{3}{2}}}$.

2. (*a*) $\dfrac{\sqrt{y^2+7}}{y}$. (*b*) $-\dfrac{(y^2+2)^3}{4y}$.

(*c*) $-\dfrac{2(y^3-3)^{\frac{3}{2}}}{3y}$. (*d*) 1.

3. (*a*) $\dfrac{7y-4x^3}{4y^3-7x}$. (*b*) $-\dfrac{3y^3+18x^2y+8x}{9xy^2+6x^3}$.

Page 68, §46

1. $\frac{1}{5}$. **2.** $\dfrac{2}{n}t^{2-n}$. **3.** $-\frac{1}{6}u^{-\frac{7}{2}}$.

Page 69, §47

1. $2\sqrt{2}$; $2\sqrt{2}$; 2; 2.
2. $y = x + 1$, equation of tangent line;
$y = -x + 3$, equation of normal line.
3. $9x + 20y = 75$. **4.** $y^2 = 8x + 1$.
5. $\sqrt{5}$. **6.** $\frac{1}{8}\sqrt{17}$. **7.** $y^2 = 2x + 7$.

Page 74, §49

Ex.	Maximum point	Minimum point	Point of inflection
1.	(0, 0)	(2, -4)	(1, -2)
2.	(-2, 4)	(0, 0)	(-1, 2)
3.	.....	.....	($-\frac{1}{2}$, 5)
4.	.....	(1, -2)	(0, 1) and ($\frac{2}{3}$, $-\frac{43}{27}$)
5.	.....	.....	(0, 0)
6.	.....	($-\frac{3}{2}$, $-35\frac{5}{8}$)	($-\frac{1}{2}$, $-13\frac{1}{8}$) and ($\frac{3}{2}$, $18\frac{7}{8}$)
7.	.....	($\frac{1}{2}$, $\frac{7}{8}$)	(0, 1) and ($\frac{1}{3}$, $\frac{25}{27}$)

Page 77, §50

1. $\frac{4}{2}m$; $\frac{15}{4}$; $10\frac{1}{6}$. **2.** $\frac{1}{3}$; $\frac{1}{6}a^2$; $\frac{1}{3}$; $\frac{1}{10}$. **3.** 2.797.

Page 81, §51

1. 20 foot-pounds. **2.** 1136 foot-pounds. **3.** 119 ergs.
4. 8920 foot-pounds. **5.** 20.83 foot-pounds.

Page 87, §54

1. 45°.

Page 99, §62

5. $\frac{2}{3}x(x^2 - 2)^{-\frac{2}{3}}dx$. **6.** $-\dfrac{1+3x}{2\sqrt{2}(x-1)^3}\,dx$.

7. $(x+1)(x-1)^2(5x+1)dx$. **8.** $3(x^2+x-2)^2(2x+1)dx$.

9. $-\frac{1}{2}(x-1)^{-\frac{3}{2}}dx$. **10.** $-3x(x^2-1)^{-\frac{5}{2}}dx$.

19. $y = Cx$. **20.** $y = C\sqrt{x^2-1}$.

21. $y = C(x^3 - 3x^2 + 12x - 2)^{\frac{1}{3}}$.

Page 102, §63

1. $\sqrt{1+9x^4}\,dx$. **2.** $\dfrac{2dx}{\sqrt{4-x^2}}$.

3. $\sqrt{1+4x^2}\,dx$. **4.** $\sqrt{1+\dfrac{1}{4x}}\,dx$.

5. $\sqrt{\dfrac{16-x^2}{16-4x^2}}\,dx$. **6.** $\sqrt{1-x^{-4}}\,dx$.

7. $\sqrt{1+\dfrac{1}{4x^3}}\,dx$. **8.** $\sqrt{1+\dfrac{9}{4x^5}}\,dx$.

Page 105, §65

1. 14. **2.** $\frac{3}{4}$. **3.** $\frac{1}{3}a^3(2\sqrt{2}-1)$.

Page 109, §67

2. 121,100 foot-pounds. **3.** 21,880 foot-pounds.
4. 160 inch-pounds. **5.** 1012.5 inch-pounds.
6. $19{,}475\mu + 3950$ foot-pounds.

Page 110, §68

1. 27π. **2.** $\frac{4}{3}\pi r^3$. **3.** 48π; 64π. **4.** 64π.
5. $\frac{32}{105}\pi a^3$. **6.** $\frac{4}{3}\pi a^3$. **7.** $\frac{1}{4}\pi$.

Page 112, §69

1. 1.736. **2.** $6a$. **3.** $a\int_0^a \frac{dx}{\sqrt{a^2 - x^2}}$

4. 16.67.

Page 113, §70

1. $16\sqrt{6}\pi$. **2.** $4\pi a^2$. **3.** $\frac{250}{3}\pi$. **4.** $\frac{12}{5}\pi a^2$.

Page 116, §72

1. 6000; 18,500 pounds. **2.** 5208 pounds.

Page 121, §74

1. $\frac{2}{3}\sqrt{3}$. **2.** 1.724. **3.** 6. **4.** 30. **5.** $\frac{3}{4}$.

6. 17.9. **8.** $5k$. **9.** $2g$. **10.** 100. **11.** $6\frac{2}{3}$; $7\frac{1}{2}$.

12. $\frac{\pi r}{4}$, where r is the radius.

Page 130, §76

12. $2 \sin 2x(\sec^2 2x + 1)dx$. **13.** $\frac{2\cos^2 2x + 4\sin^2 2x}{\cos^3 2x}dx$.

14. $(2x + 3)\cos(x^2 + 3x - 2)dx$.

15. $2(3 - x)\sin(3 - x)^2 dx$.

16. $\frac{\cos 2x}{\sqrt{\sin 2x}}dx$. **17.** $(\cos 2x - 2x \sin 2x - 2\sec^2 2x)dx$.

20. $\cot^{\frac{1}{2}}(2x - 1)[\cos^2(2x - 1) - 3\sin^2(2x - 1)]dx$.

31. 2. **32.** πa^2. **33.** $8a$.

34. $3\pi a^2$. **35.** πa^2. **36.** πab.

37. $-\tan\phi$; $6a$. **38.** $\frac{1}{2}\pi^2$.

39. 4.37 feet per second. **40.** 5.364 feet per minute.

41. $\frac{2\sqrt{y-1}}{3y-2}$. **42.** $-\frac{2x}{\cos y}$.

44. $\frac{3a^2\cos 3\theta + \rho^2 \sin\theta}{2\rho\cos\theta}$. **45.** $-\frac{1}{16}[\cos 8x + 2\cos 4x] + C$.

46. $\frac{1}{14}[\sin 7x + 7\sin x] + C$.

47. $\frac{1}{42}[7\cos 3x - 3\cos 7x] + C$.

48. $\frac{1}{110}[11\sin 5x - 5\sin 11x] + C$.

49. $\frac{1}{66}[11\cos 3x - 3\cos 11x] + C$.

50. $\frac{1}{56}[2\sin 14x + 7\sin 4x] + C$.

51. $\frac{-1}{2(\omega^2 - a^2)}[(\omega - a)\cos(\omega + a)t + (\omega + a)\cos(\omega - a)t] + C$.

52. $\frac{1}{2(\omega^2 - a^2)}[(\omega - a)\sin(\omega + a)t + (\omega + a)\sin(\omega - a)t] + C.$

53. $\frac{2}{\pi}$.

Page 134, §77

7. $\frac{-1}{2x^2 - 2x + 1}$.

8. $\frac{2(x-1)}{\sqrt{1-(1-x)^4}}$.

9. $\frac{2x}{(x^2-3)\sqrt{x^4 - 6x^2 + 8}}$.

10. $\frac{x}{\sqrt{1-x^2}} + \sin^{-1} x$.

11. $\frac{1}{2}\tan^{-1}\frac{x}{2} + C$.

15. $\frac{1}{2}\tan^{-1} x^2 + C$.

16. $\frac{1}{2}\sin^{-1} 2x + C$.

17. $\frac{1}{2}\sin^{-1}\frac{2x}{3} + C$.

19. $\frac{1}{2}\sin^{-1} x^2 + C$.

37. $\frac{\pi}{6}$.

38. $2\pi a^2$.

39. 0.848.

Page 139, §79

2. 250π feet per second.

3. -100π radians per minute per minute; $6\frac{1}{4}$ revolutions.

4. 200π revolutions.

5. $r\omega^2$ radians per second per second, or $\frac{v^2}{r}$ feet per second per second, where v is the tangential velocity; r is measured as feet and time as seconds. The acceleration is directed toward the center of the wheel.

6. $r\omega$ feet per second, if r is measured as feet and ω as radians per second. The point is moving in a direction perpendicular to the line joining it and the point of contact of the wheel with the horizontal track.

7. $(x - b)^2 + (y - c)^2 = a^2$.

Page 144, §81

1. (*a*) $\frac{2}{3}\pi$; $\frac{d^2y}{dx^2} + 9y = 0$. (*b*) $\frac{2}{3}\pi$; $\frac{d^2y}{dt^2} + 9y = 0$.

2. (*a*) $y = k\sin(3t - \alpha)$. (*b*) $y = k\sin(\sqrt{3}t - \alpha)$.

Page 148, §82

7. $e^x(\cos x - \sin x)$.

10. $\frac{2x(7 + x^2)}{1 - x^4}$.

14. $e^{-x}(\cos x - \sin x)$.

18. $x^4 5^x(5 + x \log 5)$.

34. $\log (e^x + e^{-x}) + C$.

35. $10 \log 2 = 6.93$.

37. $y = Ce^{\frac{x}{k}}$.

38. 0.4343.

39. $-\log (\csc x + \cot x) + C$.

46. 0.732.

49. $(0.4343)\ (10)^x + C$.

51. $\log \frac{\pi}{2} = 0.451$.

55. $\frac{-1}{3(a^2 + x^3)} + C$.

63. $\log 2 = 0.693$.

Page 154, §83

1. $\frac{x - 119}{35(x + 1)^{\frac{4}{7}}(x - 5)^{\frac{7}{5}}}$.

2. $\frac{(x + 3)(133 - 8x - 5x^2)}{(x - 4)^4(x - 5)^5}$.

3. $\frac{17x + 29}{6(x + 1)^{\frac{1}{3}}(2x + 5)^{\frac{1}{4}}}$.

4. $\frac{2 + x - 5x^2}{2\sqrt{1 - x}}$.

5. $x^{n-1}n^x(n + x \log n)$.

6. $x^{\sin x}\left[\frac{\sin x}{x} + \cos x \log x\right]$.

7. $10^{3t-2}[3(7t + 3) \log 10 + 7]$.

8. $\frac{1}{2}x^{\sqrt{x}-\frac{1}{2}}(2 + \log x)$.

9. 7.

10. $\frac{2}{x}$.

11. $-\frac{2}{x}$.

12. $\frac{n}{x}$.

13. $\frac{n}{x}$.

14. k.

15. $k \log 10$.

16. $\frac{1}{u}\frac{du}{dx} + \frac{1}{v}\frac{dv}{dx}$.

17. $\frac{1}{u}\frac{du}{dx} + \frac{1}{v}\frac{dv}{dx} + \frac{1}{w}\frac{dw}{dx}$.

19. $y = Cx^3$.

20. $y = Cx^n$.

21. $Ce^{\int F(x)dx}$.

22. $y = Ce^{kx}$.

Page 158, §84

1. qe^{-kt}.

3. $\frac{1}{k}\log\frac{b_2}{b_1}$; no.

4. $\omega_0 e^{-kt}$.

5. $\frac{\omega_0}{1 + k\omega_0 t}$.

Page 159, §85

1. $I_0 e^{-0.02t}$.

2. 8.51, assuming that the medium surrounding the body is at zero degrees temperature.

Page 165, §89

1. $\frac{2}{3}$.

2. $2\frac{1}{8}$.

3. $\frac{49}{12}$.

4. 16.1; 1.

Page 168, §90

1. $-\tan^{-1}\mu; \dfrac{W(\sin\beta - \mu\cos\beta)}{\sqrt{1-\mu^2}}$.

Page 169, §92

1. Maximum value = 2; Minimum value = -9.
2. A square of 200 units.

Page 175, §96

1. 7.92 inches. 2. $2\frac{1}{4}$ miles from A. 3. 45°.
4. 19.73 feet. 5. 11.23 feet. 6. 24 feet.
9. $\dfrac{a}{\pi}$. 10. 66° 3.6′.
11. $6\sqrt{3}$ inches by 6 inches. 12. $4\sqrt{6}$ inches by $4\sqrt{3}$ inches.
14. Part 8, $\frac{1}{6}$.

Page 181, §97

1. $-\theta$. 2. θ. 3. $\dfrac{1}{a}$. 4. $\Psi = \dfrac{\theta}{2}$.
5. $\Psi = \pi - \dfrac{\theta}{2}$. 6. $\Psi = \dfrac{\pi}{2} + \theta - \alpha$.

Page 182, §98

1. $2\pi a$. 2. $8a$. 3. $\frac{3}{2}\pi a$.
4. $\dfrac{\sqrt{1+a^2}}{a}[e^{a\pi} - 1]; \dfrac{\sqrt{1+a^2}}{a}[e^{\frac{1}{2}a\pi} - 1]$.

Page 183, §99

1. πa^2. 2. $6\pi a^2$. 3. $6\pi a^2$. 4. $\frac{25}{2}\pi$. 5. $^2\ \pi$.
6. $1\frac{1}{2}\pi a^2$. 7. 5. 8. $\frac{4}{3}\pi^3 a^2$. 9. $\dfrac{1050}{\pi^3}$. 10. $\frac{5}{4}\frac{5}{6}\pi^5$.

Page 187, §100

28. $\frac{1}{3}t^3 - \frac{1}{2}t^2 + t + 2\log(t+1) + C$.
42. $\dfrac{\sqrt{35}}{70}\log\dfrac{\sqrt{7}+\sqrt{5}x}{\sqrt{7}-\sqrt{5}x} + C$.
69. $\frac{1}{4}\log\sec.(2x^2 - 5) + C$. 71. $\frac{1}{2}\tan^{-1}(\frac{1}{2}\sin x) + C$.
73. $a^2x - \frac{2}{5}a^{\frac{4}{3}}x^{\frac{5}{3}} + \frac{2}{7}a^{\frac{2}{3}}x^{\frac{7}{3}} - \frac{1}{3}x^3 + C$.

84. $\frac{\pi}{2}$. **87.** $\log(x^2+9)+\tan^{-1}\frac{x}{3}+C$.

88. $\frac{1}{2}x^2+3x-\frac{9}{2}\log(x^2+9)-\frac{20}{3}\tan^{-1}\frac{x}{3}+C$.

102. $x-2\log(2x+7)+C$.

117. $\frac{1}{2}\log(x^2-9)+\frac{2}{3}\log\frac{x-3}{x+3}+C$.

Page 191, §101

1. $\sin^{-1}\left(\frac{x-1}{2}\right)+C$. **2.** $\frac{1}{4}\tan^{-1}\left(\frac{x+3}{4}\right)+C$.

3. $\frac{1}{4}\log\frac{x-5}{x-1}+C$.

4. $\frac{\sqrt{2}}{2}\log\left[2x+1+\sqrt{4x^2+4x-6}\right]+C$.

5. $\frac{1}{7}\log\frac{2x-1}{2x+6}+C$. **6.** $\frac{1}{\sqrt{11}}\tan^{-1}\frac{3x-2}{\sqrt{11}}+C$.

7. $\frac{\sqrt{2}}{2}\sin^{-1}\frac{4t-3}{5}+C$. **8.** $\frac{\sqrt{11}}{22}\log\frac{5x-4-\sqrt{11}}{5x-4+\sqrt{11}}+C$.

9. $\frac{\sqrt{2}}{2}\log\left[2t+1+\sqrt{4t^2+4t+2}\right]+C$.

10. $\log(x^2+6x+25)-\frac{11}{4}\tan^{-1}\left(\frac{x+3}{4}\right)+C$.

11. $2\sqrt{2x^2+2x-3}+\frac{5\sqrt{2}}{2}\log\left[(2x+1)+\sqrt{4x^2+4x-6}\right]+C$.

12. $2\log(x^2+2x+5)+\frac{7}{2}\tan^{-1}\left(\frac{x+1}{2}\right)+C$.

13. $-2\sqrt{5-4x-x^2}+5\sin^{-1}\left(\frac{x+2}{3}\right)+C$.

14. $-\frac{3}{2}\sqrt{2+3x-2x^2}-\frac{11\sqrt{2}}{8}\sin^{-1}\left(\frac{4x-3}{5}\right)+C$.

15. $-\frac{\sqrt{2}}{2}\sin^{-1}\left(\frac{4-3x}{5x}\right)+C$.

16. $-\frac{\sqrt{3}}{3}\log\frac{3(x+1)+\sqrt{15x^2+18x+9}}{x}+C$.

17. $\sin^{-1}\left(\frac{x-3}{3}\right)+C$.

18. $\frac{1}{2}\log\left[2y+3+\sqrt{4y^2+12y-7}\right]+C$.

19. $\frac{1}{30}\log\frac{x-3}{3x+1}+C$. **20.** $\frac{1}{2}\sin^{-1}\left(\frac{2x-3}{\sqrt{17}}\right)+C$.

21. $-\sqrt{2+3x-x^2}+4\sin^{-1}\left(\frac{2x-3}{\sqrt{17}}\right)+C.$

22. $\frac{\sqrt{15}}{60}\tan^{-1}\left(\frac{4x-3}{\sqrt{15}}\right)+C.$

23. $-\frac{1}{2}\log\frac{2+3x+\sqrt{4+12x-7x^2}}{x}+C.$

24. $-\frac{1}{2}\sin^{-1}\left(\frac{2-3x}{\sqrt{17}x}\right)+C.$

Page 192, §102

1. $\frac{3}{11\,2}(8x^2-18x+81)(2x+3)^{\frac{1}{3}}+C.$

2. $\frac{4}{3}[\sqrt{x+1}-3](x+1)^{\frac{1}{4}}+4\tan^{-1}(x+1)^{\frac{1}{4}}+C.$

3. $2\sqrt{x+3}+\frac{2}{\sqrt{3}}\log\frac{\sqrt{x+3}-\sqrt{3}}{\sqrt{x+3}+\sqrt{3}}+C.$

4. $4\sqrt{x-2}+3\sqrt{2}\tan^{-1}\sqrt{\frac{x-2}{2}}+C.$

5. $6\sqrt{x+1}-4\log\frac{\sqrt{x+1}-1}{\sqrt{x+1}+1}+C.$

6. $x+1+4\sqrt{x+1}+4\log(\sqrt{x+1}-1)+C.$

7. $\frac{2}{9}(6x^{\frac{1}{4}}-3x^{\frac{1}{6}}+2x^{\frac{1}{12}})-\frac{4}{2\,7}\log(3x^{\frac{1}{12}}+1)+C.$

8. $\frac{4}{4\,5}(5x-16)(x+4)^{\frac{5}{4}}+C.$

9. $\frac{1}{2}\log\frac{\sqrt{x+4}-2}{\sqrt{x+4}+2}+C.$

10. $3\sqrt{2x+3}-\frac{2}{\sqrt{3}}\log\frac{\sqrt{2x+3}-\sqrt{3}}{\sqrt{2x+3}+\sqrt{3}}+C.$

11. $\frac{1}{2\,0}[16x^{\frac{1}{4}}+15x^{\frac{1}{3}}]x+C.$

12. $\frac{2}{3}\sqrt{2x-3}+\frac{1}{9}^{0}\sqrt{3}\tan^{-1}\sqrt{\frac{2x-3}{3}}+C.$

13. $\frac{1}{7}{}_{0}[60t^6-84t^4+105t^3+140t^2-120t-420]t+3\log(t^2+1)$
$+6\tan^{-1}t+C,$ where $t=(x+2)^{\frac{1}{6}}.$

14. $2\sqrt{x-3}-2\sqrt{7}\tan^{-1}\sqrt{\frac{x-3}{7}}+C.$

15. $\frac{1}{3}{}^{0}[x^{\frac{3}{1}{}^{0}}-3x^{\frac{1}{1}{}^{0}}]+5\log(1+x^{\frac{1}{5}})+10\tan^{-1}x^{\frac{1}{1}{}^{0}}+C.$

16. $\frac{2}{3}\sqrt{2x+3}+\frac{\sqrt{39}}{9}\log\frac{\sqrt{3}\sqrt{2x+3}-\sqrt{13}}{\sqrt{3}\sqrt{2x+3}+\sqrt{13}}+C.$

Page 194, §103,(a)

1. $-\cos x + \frac{2}{3}\cos^3 x - \frac{1}{5}\cos^5 x + C.$
2. $\frac{1}{3}\sin^3 x - \frac{1}{5}\sin^5 x + C.$
3. $\frac{1}{4}\sin^4 x - \frac{1}{6}\sin^6 x + C.$
4. $\frac{1}{3}\cos^3 x - \cos x + C.$
5. $\frac{2}{3}(\sin x)^{\frac{3}{2}} - \frac{2}{7}(\sin x)^{\frac{7}{2}} + C.$
6. $\frac{1}{7}\cos^7 x - \frac{1}{5}\cos^5 x + C.$
7. $2(\sin x)^{\frac{1}{2}} - \frac{2}{5}(\sin x)^{\frac{5}{2}} + C.$
8. $-\frac{3}{2}(\cos\theta)^{\frac{2}{3}} + \frac{3}{4}(\cos\theta)^{\frac{8}{3}} - \frac{3}{14}(\cos\theta)^{\frac{14}{3}} + C.$
9. $\frac{1}{3}\sin^3\alpha - \frac{1}{5}\sin^5\alpha + C.$
10. $-\frac{1}{6}\cos^3(2x+3) + \frac{1}{10}\cos^5(2x+3) + C.$

Page 195, §103, (b)

1. $\frac{1}{4}(2x - \sin 2x) + C.$
2. $\frac{1}{64}(24x + 8\sin 4x + \sin 8x) + C.$
3. $\frac{1}{192}(12x - 3\sin 4x - 4\sin^3 2x) + C.$
4. $\frac{1}{32}(12x - 8\sin 2x + \sin 4x) + C.$
5. $\frac{1}{12}(6x - \sin 6x) + C.$
6. $\frac{1}{160}(60x + 8\sin 10x + \sin 20x) + C.$

Page 196, §103, (c) and (e)

1. $\frac{1}{4}\sec^4 x - \sec^2 x + \log\sec x + C.$
2. $-\frac{1}{3}\cot^3 x - \cot x + C.$
3. $\frac{1}{3}\tan^3 x + \frac{2}{5}\tan^5 x + \frac{1}{7}\tan^7 x + C.$
4. $\frac{1}{7}\sec^7 x - \frac{1}{5}\sec^5 x + C.$
5. $-\frac{1}{3}\cot^3 x + \cot x + x + C.$
6. $-\cot x - \frac{2}{3}\cot^3 x - \frac{1}{5}\cot^5 x + C.$
7. $\frac{1}{5}\tan^5 x + C.$
8. $\tan x + \frac{2}{3}\tan^3 x + \frac{1}{5}\tan^5 x + C.$
9. $\frac{1}{7}\sec^7 x - \frac{2}{5}\sec^5 x + \frac{1}{3}\sec^3 x + C.$
10. $\frac{1}{7}\tan^7 x + \frac{1}{9}\tan^9 x + C.$
11. $\frac{3}{5}(\tan x)^{\frac{5}{3}} + \frac{3}{11}(\tan x)^{\frac{11}{3}} + C.$
12. $\frac{1}{3}\tan^3 x + C.$
13. $\frac{2}{5}(\tan x)^{\frac{5}{2}} + \frac{4}{9}(\tan x)^{\frac{9}{2}} + \frac{2}{13}(\tan x)^{\frac{13}{2}} + C.$
14. $\frac{1}{2}(\sec^2\theta - \csc^2\theta) - \log\sin\theta + \log\cos\theta + 2\theta + C.$
15. $\tan\theta - \theta + C.$
16. $\frac{1}{3}\cot^3\theta(3\tan^4\theta - 6\tan^2\theta - 1) + C.$

Page 199, §104

1. $\log(x + \sqrt{x^2 - a^2}) + C.$
2. $\int \frac{\sqrt{a^2+x^2}}{x^2}\,dx = \log(x + \sqrt{a^2+x^2}) - \frac{\sqrt{a^2+x^2}}{x} + C.$
3. $\frac{1}{15}(3x^2 - 2)(1 + x^2)^{\frac{3}{2}} + C.$

4. $\frac{1}{a}\log\frac{x}{a+\sqrt{a^2+x^2}}+C.$

5. $\frac{1}{a}\log\frac{x}{a+\sqrt{a^2-x^2}}+C.$

6. $\frac{1}{\sqrt{7}}\log\frac{x}{\sqrt{7}+\sqrt{7-3x}}+C.$

7. $-\frac{1}{81}\frac{2x^2+9}{x\sqrt{x^2+9}}+C.$

8. $\frac{x+1}{\sqrt{1-x^2}}+C.$

9. $\frac{x-2}{\sqrt{4x-3-x^2}}+C.$

10. $\frac{3}{8}a^2[\frac{1}{6}\sin^3 2\theta-\frac{1}{8}\sin 4\theta+\frac{1}{2}\theta]+C$, where $\theta=\sin^{-1}\left(\frac{x}{a}\right)^{\frac{1}{3}}$.

11. $\frac{a^2}{2}[\sin^{-1}\frac{x}{a}-\frac{x}{a^2}\sqrt{a^2-x^2}]+C.$

12. $\frac{\sqrt{5}}{10}[9\sin^{-1}\frac{\sqrt{5}x}{3}+\sqrt{5}x\sqrt{9-5x^2}]+C.$

13. $\frac{1}{54}[\sec^{-1}\frac{x}{3}+\frac{3}{x^2}\sqrt{x^2-9}]+C.$

14. $\frac{81}{8}[3\sin^{-1}\frac{x}{3}+\frac{x}{81}(45-2x^2)\sqrt{9-x^2}]+C.$

15. $-\frac{1}{8}\left[\frac{2}{\sqrt{x^2-4}}+\sec^{-1}\frac{x}{2}\right]+C.$

16. $\frac{1}{16}\frac{x}{\sqrt{16-x^2}}+C.$

17. $\frac{1}{16}\frac{x+3}{\sqrt{x^2+6x+25}}+C.$

18. $\frac{1}{2}[27\sin^{-1}\frac{x-3}{3}-(x+9)\sqrt{6x-x^2}]+C.$

19. $-\frac{1}{9}\frac{x+2}{\sqrt{x^2+4x-5}}+C.$

20. $\sin^{-1}\frac{x-3}{\sqrt{11}}+C.$

Page 201, §105

1. $\frac{2}{16}\frac{43}{}\pi.$ 2. $\frac{\pi}{2}.$ 3. $\frac{9}{4}\pi.$ 4. $\frac{\pi}{2}.$

5. $\frac{25}{4}\pi.$ 6. $\frac{9}{4}\pi.$ 7. $\frac{\sqrt{2}}{2a^2}.$ 8. 0.0855.

9. $\frac{\pi+2}{512}.$ 10. $\frac{\sqrt{3}}{18}.$ 11. $\frac{9}{4}\pi.$ 12. $\frac{\pi}{4}(b^2-y^2).$

Page 202, §106

1. $\frac{x^3}{9}(3 \log x - 1) + C.$
2. $x \sin x + \cos x + C.$
3. $x \sin^{-1} x + \sqrt{1 - x^2} + C.$
4. $\frac{1}{3}\frac{1}{2}e^{4x}(8x^2 - 4x + 1) + C.$
5. $x \tan^{-1} x - \log \sqrt{1 + x^2} + C.$
6. $\sin x - x \cos x + C.$
7. $\frac{x^{n+1}}{(n+1)^2}[(n+1) \log x - 1] + C.$
8. $\frac{1}{48}[16x^3 \tan^{-1} 2x - 4x^2 + \log (4x^2 + 1)] + C.$
9. $\frac{1}{9} \sin x(12 - \sin^2 x) - \frac{1}{3}x \cos x(3 + \cos^2 x) + C.$
10. $x(\log x - 1) + C.$
11. $\frac{1}{4}(\cos 2x + 2x \sin 2x - 2x^2 \cos 2x) + C.$
12. $\cos x(1 - \log \cos x) + C.$

Page 203, §106

1. $\frac{e^{-5t}}{8.602} \sin (7t - \alpha) + C$, where $\alpha = 125° 32'.$
2. $\frac{e^{-3t}}{8.544} \cos (8t - \alpha) + C$, where $\alpha = 110° 34'.$
3. $\frac{e^{-0.5t}}{3.041} \sin (3t - \alpha) + C$, where $\alpha = 99° 28'.$
4. $\frac{e^{-0.2t}}{4.005} \cos (4t - \alpha) + C$, where $\alpha = 92° 50'.$
5. $\frac{e^{-x}}{\sqrt{2}} \sin (x - \alpha) + C$, where $\alpha = 135°.$
6. $\frac{e^{-3t}}{5.831} \cos (5t - \alpha) + C$, where $\alpha = 121°.$
7. $\frac{e^{-0.4t}}{\sqrt{\omega^2 + 0.16}} \sin (\omega t - \alpha) + C.$
8. $\frac{e^{-0.2t}}{\sqrt{\omega^2 + 0.04}} \cos (\omega t - \alpha) + C.$
9. $\frac{e^{-0.4t}}{5.016} \cos (5t - \alpha) + C$, where $\alpha = 94° 35'.$
10. $\frac{e^{-0.3t}}{4.011} \sin (4t - \alpha) + C$, where $\alpha = 94° 17'.$

Page 204, §108

1. $-\frac{1}{2}[\csc x \cot x + \log (\csc x + \cot x)] + C.$
2. $\frac{1}{4} \sec^3 x \tan x + \frac{3}{8}[\sec x \tan x + \log (\sec x + \tan x)] + C.$
3. $a^4 \int \sec^5 \alpha \, d\alpha + C$, where $\alpha = \sec^{-1} \frac{x}{a}.$

4. $a^2\int_0^{\frac{\pi}{4}} \sec^3\alpha\, d\alpha.$

5. $a^2\int \sec^3\alpha\, d\alpha + C$, where $\alpha = \tan^{-1}\frac{x}{a}$.

6. $7\int \sec^3\alpha\, d\alpha + C$, where $\alpha = \tan^{-1}\frac{x-2}{\sqrt{7}}$.

7. $a^4\int_0^{\frac{\pi}{3}} \sec^5\alpha\, d\alpha.$

8. $9\int_0^{\frac{\pi}{3}} (\sec^3\alpha - \sec\alpha) d\alpha.$

Page 208, §109

1. $\frac{8}{15}$. 2. $\frac{63}{512}\pi$. 3. $\frac{128}{315}$. 4. $\frac{5}{32}\pi$. 5. $\frac{5}{32}\pi$.
6. $\frac{35}{256}\pi$. 7. $\frac{256}{693}$. 8. $\frac{16}{35}$. 9. $\frac{8}{315}$. 10. $\frac{1}{24}$.
11. $\frac{3\pi}{512}$. 12. $\frac{1}{6}$. 13. $\frac{7}{512}\pi$. 14. $\frac{8}{315}$.
15. $\frac{3}{16}\pi a^4$. 16. $\frac{1}{32}\pi a^6$. 17. $\frac{3}{32}\pi a^2$. 18. $\frac{8}{105}a^3$.
19. $\frac{3}{2}\pi a^2$. 20. $\frac{1}{8}\pi$. 21. $\frac{3}{8}\pi a^4$. 22. $\frac{1}{2}\pi a^3$.

Page 211, §110

1. $\frac{1}{4}\log\dfrac{2+\tan\frac{x}{2}}{2-\tan\frac{x}{2}} + C.$ 2. $\frac{1}{2}\tan^{-1}\left(2\tan\frac{x}{2}\right) + C.$

3. $\frac{1}{3}\log\dfrac{\tan\frac{x}{2}-2}{2\tan\frac{x}{2}-1} + C.$

4. $x - \dfrac{4\sqrt{3}}{3}\tan^{-1}\left[\dfrac{2\tan\frac{x}{2}+1}{\sqrt{3}}\right] + C.$

5. $\frac{1}{2}x + \dfrac{3\sqrt{5}}{5}\tan^{-1}\left[\dfrac{\tan\frac{x}{2}}{\sqrt{5}}\right] + C.$

6. $-\frac{1}{3}\log(1-3\sin x) + C.$

7. $2x + \dfrac{1}{\sqrt{3}}\log\dfrac{\tan\frac{x}{2}+2-\sqrt{3}}{\tan\frac{x}{2}+2+\sqrt{3}} + C.$

8. $\frac{1}{2}\csc^2 x + \tan\frac{x}{2} - \frac{1}{2}\sec x \cot x - \frac{1}{2}\log(\csc x + \cot x) + C.$

9. $\frac{1}{4}\tan^{-1}\left[\frac{5\tan x - 3}{4}\right] + C.$

10. $\frac{1}{6}\log\frac{3\tan x - 1}{3\tan x + 1} + C.$

Page 217, §111

1. $\frac{5}{13}\log(x-2) + \frac{4}{13}\log(x^2+2x+5) + \frac{11}{26}\tan^{-1}\left(\frac{x+1}{2}\right) + C.$

2. $\log(x+1)^2 + \frac{4x+3}{(x+1)^2} + C.$

3. $-\frac{4}{9}\log x + \frac{4}{9}\log(x-3) + \frac{1}{3}\frac{1}{(x-3)} + C.$

4. $\frac{1}{10}\log\frac{x^2+4}{(x+1)^2} + \frac{2}{5}\tan^{-1}\frac{x}{2} + C.$

5. $\frac{3}{2}\log(x-1) - \frac{5}{4}\log(x^2-2x+5) + \tan^{-1}\left(\frac{x-1}{2}\right) + C.$

6. $\frac{3}{7}\log(x+4) + \frac{23}{28}\log(2x+1) - \frac{7}{4}\frac{1}{(2x-1)} + C.$

7. $\log\sqrt{x^2+1} + \tan^{-1}x - 3(x^2+1)^{-1} + C.$

8. $\frac{1}{2}(x+1)^2 - \frac{1}{3}\log x + \frac{19}{6}\log(x+3) + \frac{37}{6}\log(x-3) + C.$

Page 219, §112

1. $\frac{1}{4}\pi a^2.$
2. $a^2.$
3. $\frac{1}{2}\pi a.$
4. $10\pi.$
5. $\frac{4}{3}\pi a^3.$
6. $49\frac{1}{2}\frac{7}{7}.$
7. $4\pi a^2.$
8. 200 foot-pounds.
9. 300 pounds.
10. $6a.$
12. $\frac{1}{4}\pi ab.$
13. $\frac{1}{8}\pi a^2.$
14. $8a.$
15. $\frac{1}{3}\pi a^2 b.$
16. 11.08.
17. $\frac{1}{2}\pi a^2 \sinh\frac{2x_1}{a} + \pi a x.$
18. $3\pi a^2.$
19. 2.078.
20. $\frac{1}{4}\pi a^3 \sinh\frac{2b}{a} + \frac{1}{2}\pi a^2 b.$
21. $\frac{32}{105}\pi a^3.$
22. $6\frac{2}{3}.$
23. 72.
24. 2.
25. $C\log\frac{V_2}{V_1}.$
27. $3\pi.$
28. $\frac{\sqrt{1+a^2}}{a}[e^{2\pi a} - 1].$
29. $\frac{\sqrt{1+a^2}}{a}.$
30. $\frac{3}{5}\pi a^2.$
31. $25\pi.$
32. $\frac{3}{8}\pi a^2.$
33. $4\pi - 21\frac{1}{3}.$
34. 9704 foot-pounds.
35. 9498.
36. 63,540 pounds.
37. $a^2 \sinh 1.$
38. $\frac{a}{2}[2\pi\sqrt{1+4\pi^2} + \log(2\pi + \sqrt{1+4\pi^2}).$

39. $a\int_0^{\frac{\pi}{2}} \sqrt{1-\epsilon\sin^2 u}\,du$, where ϵ is the eccentricity of the ellipse, $u = \frac{\pi}{2} - \theta$, and $a > b$.

40. $(512)(2340.4)\pi$. **41.** $5\pi^2a^3$.

42. $\frac{1}{6}\pi a^3(3\pi - 4)$. **43.** $\frac{1}{2}\pi kr^2h^2$.

44. 4690 foot-pounds. **45.** $\frac{2}{3}^5\pi$.

46. $a\sinh\frac{x_1}{a}$. **47.** $8a$.

48. $2\pi^2a^2b$. **49.** $\frac{3}{3}\frac{3}{8}\frac{4}{4}a^2(20\pi + 1 - 39\sqrt{3})$.

50. 184,300 foot-pounds. **51.** $\frac{1}{3}^6a^3$.

52. $\frac{6}{3}^4\pi a^2$. **53.** 11π. **54.** $2.278\pi - 3\sqrt{5}$.

55. $\frac{1}{5}^6a^2$. **56.** $\frac{8}{3}\pi a^3$.

Page 226, §113

1. 2. **2.** No limit. **3.** No limit. **4.** $2\sqrt{2}$.

5. No limit. **6.** $2\sqrt{a}$. **7.** $\frac{1}{2}\pi$. **8.** $\frac{1}{2}\pi$.

9. No limit. **10.** 6. **11.** $3(2^{\frac{1}{3}} + 3^{\frac{1}{3}})$. **12.** $\frac{3}{2}\pi a^2$.

Page 227, §114

1. 1. **2.** 1. **3.** 1. **4.** 2. **5.** $4\pi a^2$.

Page 230, §116

1. $\sqrt{29}$. **2.** $\sqrt{40}$. **3.** $\sqrt{13}$. **4.** $\sqrt{13}$. **5.** $\sqrt{130}$. **6.** $\sqrt{14}$.

Page 231, §117

1. $\frac{1}{3}\sqrt{3}, \frac{1}{3}\sqrt{3}, \frac{1}{3}\sqrt{3}$. **2.** $\frac{2}{\sqrt{29}}, \frac{-3}{\sqrt{29}}, \frac{4}{\sqrt{29}}$.

3. $\frac{-1}{\sqrt{14}}, \frac{2}{\sqrt{14}}, \frac{-3}{\sqrt{14}}$. **4.** $\frac{1}{3}\sqrt{3}, \frac{1}{3}\sqrt{3}, \frac{1}{3}\sqrt{3}$.

5. $\frac{-1}{\sqrt{66}}, \frac{-7}{\sqrt{66}}, \frac{4}{\sqrt{66}}$.

Page 232, §118

1 and **2.** $\frac{3}{\sqrt{87}}$. **2** and **3.** $\frac{-20}{\sqrt{406}}$.

3 and **4.** $\frac{-2}{\sqrt{42}}$.

Page 233, §119

1. $x - \sqrt{2}y - z = 4$, if the normal extends into the eighth octant.

2. $x - y + \sqrt{2}z + 10 = 0$.

Page 234, §120

1. $\frac{3}{\sqrt{14}}x - \frac{2}{\sqrt{14}}y - \frac{1}{\sqrt{14}}z = \frac{1}{\sqrt{14}}$; $\frac{1}{\sqrt{14}}$; eighth.

2. $-\frac{1}{3}\sqrt{3}x - \frac{1}{3}\sqrt{3}y - \frac{1}{3}\sqrt{3}z = \frac{1}{3}\sqrt{3}$; $\frac{1}{3}\sqrt{3}$; seventh.

3. $\frac{1}{\sqrt{14}}x - \frac{3}{\sqrt{14}}y + \frac{2}{\sqrt{14}}z = \frac{3}{\sqrt{14}}$; $\frac{3}{\sqrt{14}}$; fourth.

6. $\frac{1}{\sqrt{5}}x + \frac{2}{\sqrt{5}}y = \frac{6}{\sqrt{5}}$; $\frac{6}{\sqrt{5}}$; in the xy-plane between the first and fifth octants.

Page 236, §121

1. $\frac{x}{3} + \frac{y}{3} + \frac{z}{3} = 1$.

2. $\frac{x}{\frac{7}{2}} + \frac{y}{-\frac{7}{3}} + \frac{z}{\frac{7}{4}} = 1$.

Page 326, §122

1. 79° 7′.

2. 122° 19′.

Page 238, §124

1. $\frac{4}{7}\sqrt{14}$.

2. $\frac{2}{3}\sqrt{6}$.

3. $\frac{11}{38}\sqrt{38}$.

Page 240, §125

1. $\frac{x - \frac{8}{3}}{-\frac{1}{\sqrt{26}}} = \frac{y - \frac{5}{3}}{-\frac{4}{\sqrt{26}}} = \frac{z - 0}{\frac{3}{\sqrt{26}}}$.

2. $\frac{x - \frac{8}{3}}{\frac{1}{\sqrt{26}}} = \frac{y - 0}{\frac{3}{\sqrt{26}}} = \frac{z - \frac{5}{3}}{\frac{4}{\sqrt{26}}}$.

3. $\frac{x - 0}{-\frac{1}{\sqrt{35}}} = \frac{y - 0}{\frac{5}{\sqrt{35}}} = \frac{z - 0}{\frac{3}{\sqrt{35}}}$.

Page 241, §126

1. $x^2 + z^2 = y$.

2. $y^2 + z^2 = (x^2 - a^2)^2$.

Page 249, §130

1. (*a*) 0; $\frac{2x}{y^3}$; $-\frac{1}{y^2}$.

2. (*a*) $2x$. (*b*) $\frac{1}{\sqrt{1 - y^2}}$.

Page 252, §132

1. 3. **2.** $\frac{1}{8}$. **3.** $-\frac{94}{195}$. **4.** $\frac{3}{4}\pi a^2$.

5. $\frac{1}{4}a^2(\pi - 2)$. **6.** 15,750 **7.** $\frac{2}{3}a^3$. **8.** $\frac{2}{5}a^{\frac{5}{2}} - \frac{1}{4}a^4$

9. $\frac{6}{35}$. **10.** $\frac{1}{3}$. **11.** $\frac{3}{20}$. **12.** $\frac{1}{6}\pi a^3$.

Page 255, §133

1. $\frac{1}{10}$ **3.** $\frac{1}{12}a^2(3\pi - 8)$. **4.** $\frac{1}{12}a^2(3\pi - 8)$

6. $3\frac{1}{3}$. **8.** 0.879.

Page 258, §134

1. $25\sqrt{2}\pi$. **2.** $\frac{1}{3}$. **3.** $\frac{16}{3}a^3$. **4.** $\frac{1}{10}$.

Page 260, §135

1. $\frac{25}{4}\pi$. **2.** $3\pi a^2$. **3.** a^2. **4.** πa^2.

Page 262, §136

1. $\frac{16}{3}r^3$. **2.** $\frac{2}{3}mr^3$. **3.** $\frac{1}{6}abc$.

4. $$\int_0^a \int_0^{(a^{\frac{2}{3}} - x^{\frac{2}{3}})^{\frac{3}{2}}} \int_0^{(a^{\frac{2}{3}} - x^{\frac{2}{3}} - y^{\frac{2}{3}})^{\frac{3}{2}}} dz\, dy\, dx.$$

5. $8\pi a^3$. **6.** $\frac{52}{35}$. **7.** $\frac{1}{4}\sqrt{2}\pi$.

Page 270, §140

1. $\bar{x} = \bar{y} = \frac{9}{29}$.

2. Part **1.** $\bar{x} = \frac{10}{21}$, $\bar{y} = \frac{5}{12}$. Part **3.** $\bar{x} = \dfrac{4a}{5(3\pi - 8)}$, $\bar{y} = \dfrac{a}{3\pi - 8}$.

Part **6.** $x = \frac{31}{25}$, $\bar{y} = \frac{7}{10}$.

4. $\bar{y} = \dfrac{4r}{3\pi}$. **7.** $\bar{x} = \bar{y} = \dfrac{2r}{\pi}$. **11.** $\bar{x} = \frac{1}{2}r$.

12. $\bar{x} = \frac{2}{3}h$. **13.** $\bar{x} = \frac{3}{8}a$.

14. $$\bar{x} = \frac{(6h - a)(4h + a)^{\frac{3}{2}} + a^{\frac{5}{2}}}{10[(4h + a)^{\frac{3}{2}} - a^{\frac{3}{2}}]}.$$

15. On a line joining the apex with the centroid of the boundary of the base, at a point two-thirds of the way from the apex to the centroid.

16. $\bar{x} = \pi a$, $\bar{y} = \frac{5}{6}a$. **17.** $\bar{x} = \pi a$, $\bar{y} = \frac{1}{3}a$.

18. $\bar{x} = \bar{y} = \dfrac{256a}{315\pi}$. **19.** $\bar{x} = \bar{y} = \frac{8}{5}a$.

23. $\bar{z} = \bar{y}$ $\frac{9}{64}\pi a$, $\bar{x} = \frac{3}{8}a$.

Page 275, §141

1. $4\pi^2ab$. 2. $2\pi^2a^2b$. 4. $\bar{x} = \bar{y} = \frac{4a}{3\pi}$.

Page 276, §142

1. Part 1. $\bar{x} = \frac{3}{8}a$, $\bar{y} = 0$. Part 2. $\bar{x} = \frac{5}{8}a$, $\bar{y} = \frac{16a}{9\pi}$.

2. $\bar{x} = \frac{4}{3}a - \frac{76\sqrt{2}a}{105\pi}$. 3. $\frac{2a \sin \alpha}{3\alpha}$.

4. $\bar{x} = \bar{y} = \frac{4}{3}\frac{a}{\pi}$.

Page 282, §145

1. $\frac{1}{3}ab(a^2 + b^2)$; $\frac{1}{12}ab(a^2 + b^2)$; $\frac{1}{3}ab^3$; $\frac{1}{12}ab^3$.
2. $\frac{1}{12}ab^3$; $\frac{1}{36}ab^3$. 3. $\frac{3}{2}\pi a^4$. 4. $\frac{1}{4}\pi a^4$. 5. $\frac{5}{4}\pi a^4$.
6. $\frac{6}{35}$. 7. $\frac{1}{3}\rho L^3$; $\frac{1}{12}\rho L^3$. 8. $\frac{1}{4}kL^4$. 10. $\frac{1}{3}mL^2 \sin^2 \alpha$.
11. $2\alpha r^3$; $\frac{1}{2}r^3(2\alpha - \sin 2\alpha)$; $\frac{1}{2}r^3(2\alpha + \sin 2\alpha)$.
12. $\frac{1}{4}bh^3$. 13. $\frac{1}{36}bh^3$.
14. $\frac{1}{4}\pi ab^3$; $\frac{1}{4}\pi a^3b$; $\frac{1}{4}\pi ab(a^2 + b^2)$.

Page 283, §146

1. $\frac{3}{16}\frac{5}{2}\pi a^4$; $\frac{2}{3}\frac{1}{2}\pi a^4$. 2. $\frac{a^4(45\pi - 128)}{1920}$.
3. $\frac{1}{8}a^4(2\alpha - \sin 2\alpha)$. 4. $\frac{1}{2}a^3(2\alpha - \sin 2\alpha)$.
5. $\frac{1}{2}\alpha a^4$; $\frac{1}{2}\alpha a^4 - \frac{4}{9}\frac{a^4 \sin^2 \alpha}{\alpha}$.

Page 287, §147

1. $\frac{\pi b^2h(4b^2 + h^2)}{80}$; $\frac{\pi b^2h(3b^2 + 2h^2)}{60}$.
2. $\frac{\pi r^2h}{12}(3r^2 + 4h^2)$; $\frac{\pi r^2h}{12}(3r^2 + h^2)$.
3. $\frac{1}{12}abc(c^2 + b^2)$. 4. $\frac{1}{2}\pi r^4h$.
5. $\frac{1}{2}\pi(R^4 - r^4)h$; $\frac{\pi h}{12}(R^2 - r^2)(3R^2 + 3r^2 + 4h^2)$;
$\frac{\pi h}{12}(R^2 - r^2)(3R^2 + 3r^2 + h^2)$.
8. $\frac{8}{15}\pi(R^5 - r^5)$. 11. $\frac{1}{10}\pi r^4h$. 12. $\frac{1}{12}\pi abL(3a^2 + L^2)$.
13. $\frac{1}{16}\pi a^4$. 14. $\frac{1}{6}\sqrt{3}a^4$; $\frac{7}{6}\sqrt{3}a^4$.

Page 292, §151

1. $\frac{2}{[5 - 8x + 4x^2]^{\frac{3}{2}}}$. 2. $\frac{6}{\sqrt{x}[4 + 9x]^{\frac{3}{2}}}$.

3. $\dfrac{2x^3}{[x^4+1]^{\frac{3}{2}}}$.

4. $\dfrac{2(1-3x)}{[1+(2x-3x^2)^2]^{\frac{3}{2}}}$.

5. $\dfrac{18x^5}{[x^6+36]^{\frac{3}{2}}}$.

6. $\dfrac{2}{[4x+1]^{\frac{3}{2}}}$.

7. $\dfrac{2x^{\frac{1}{3}}}{3[x^{\frac{4}{3}}+1]^{\frac{3}{2}}}$.

8. $\dfrac{30x^4}{[4x^5+9]^{\frac{3}{2}}}$.

9. $\dfrac{6x^2}{[4x^3+1]^{\frac{3}{2}}}$.

Page 293, §152

1. $\dfrac{1}{a[\sinh^2 t+\cosh^2 t]^{\frac{3}{2}}}$.

2. $\dfrac{1}{4a}\csc\dfrac{t}{2}$.

Page 296, §152

1. $216x^2=(8y-3)^3$.

Page 299, §155

1. $y^2=4px$.

2. $x^2+y^2=a^2$.

3. $x^2-4y^2=0$, two straight lines.

4. $x^{\frac{2}{3}}+y^{\frac{2}{3}}=a^{\frac{2}{3}}$, where a is the constant length and the coördinate axes are the mutually perpendicular lines.

5. $x^2=4y$.

6. $y^2=4p(x+p)$.

Page 313, §163

1. $\cos x=1-\dfrac{x^2}{\lfloor 2}+\dfrac{x^4}{\lfloor 4}-\dfrac{x^6}{\lfloor 6}+\ldots$

2. $\cos x=\cos a-(x-a)\sin a-\dfrac{(x-a)^2}{\lfloor 2}\cos a+\dfrac{(x-a)^3}{\lfloor 3}\sin a+\ldots$

3. $\cos(a+h)=\cos a-h\sin a-\dfrac{h^2}{\lfloor 2}\cos a+\dfrac{h^3}{\lfloor 3}\sin a+\ldots$

4. $\sin(a+h)=\sin a+h\cos a-\dfrac{h^2}{\lfloor 2}\sin a-\dfrac{h^3}{\lfloor 3}\cos a+\ldots$

5. Part 1. $-\dfrac{x^6}{\lfloor 6}\cos x_6$; Part 2. $\dfrac{(x-a)^3}{\lfloor 3}\sin x_3$;
Part 3. $\dfrac{h^3}{\lfloor 3}\sin x_3$; Part 4. $-\dfrac{h^3}{\lfloor 3}\cos x_3$.

6. $e^x=1+x+\dfrac{x^2}{\lfloor 2}+\dfrac{x^3}{\lfloor 3}+\dfrac{x^4}{\lfloor 4}+\ldots$

7. $e^{a+h} = e^a\left[1 + h + \frac{h^2}{\lfloor 2} + \frac{h^3}{\lfloor 3} + \frac{h^4}{\lfloor 4} + \ldots\right]$.

8. $e^x = e^a\left[1 + (x-a) + \frac{(x-a)^2}{\lfloor 2} + \frac{(x-a)^3}{\lfloor 3} + \ldots\right]$.

9. $\log(1+x) = x - \frac{x^2}{2} + \frac{x^3}{3} - \ldots$

10. $\log(1-x) = -\left[x + \frac{x^2}{2} + \frac{x^3}{3} + \ldots\right]$.

11. $\tan^{-1} x = x - \frac{x^3}{3} + \frac{x^5}{5} - \frac{x^7}{7} + \ldots$

12. (*a*) 1.39561; (*b*) 1.105171; (*c*) 0.052336; (*d*) 0.5403.

13. 0.8387. **14.** 0.5299.

Page 319, §165

1. Convergent. **2.** Divergent. **3.** Divergent.
4. Divergent. **5.** Convergent. **6.** Convergent.
7. Convergent. **8.** Convergent. **9.** Convergent.
10. For all values. **11.** For all values.
12. For all values. **13.** $-1 \leqq x < +1$.
14. $-1 \leqq x \leqq +1$.

Page 323, §169

1. $-2 + 2i$. **2.** $-\frac{1}{2} + \frac{\sqrt{3}}{2}i$. **3.** -1.
4. 1. **5.** 1. **6.** -125.

Page 324, §169

2. $\sqrt{2}e^{\frac{\pi i}{8}}$, and $\sqrt{2}e^{\frac{9\pi i}{8}}$.

Page 327, §170

1. 1. **2.** $\frac{1}{2}$. **3.** 0. **4.** 3.
5. n. **6.** $\frac{3}{2}$. **7.** 3. **8.** -6.
9. $\frac{5}{6}$. **10.** $\frac{3}{4}$. **11.** 0. **12.** 0.
13. ∞, if $n > 0$. **14.** 0. **15.** ∞. **16.** ∞.
17. $-\frac{1}{2}$. **18.** 1. **19.** $\frac{1}{2}$. **20.** 1.
21. e^{-1}. **22.** 1. **23.** 1. **24.** 1.
25. 1.

Page 331, §171

12. 372 cubic inches per hour.
13. -8.4 pounds per square foot.
14. -25.4 pounds per square foot per second.
15. 5.32 cubic feet per second.

Page 336, §173

1. $x^3y^2 = C$.
2. $\sin \frac{x}{y} = C$.
3. Not exact.
4. $e^{xy} = C$.
5. Not exact.
6. $\frac{x^2}{y^3} + x - y^2 = C$.
7. Not exact.

Page 340, §178

2. $\cos y = C \cos x$.
3. $[x + \sqrt{1 + x^2}]\,[y + \sqrt{1 + y^2}] = C\sqrt{1 + x^2}$.
4. $5x^2y = Cy - 2$.
5. $x + y + 4 = C(xy + 2x + 2y + 3)$.
7. $\log (xy) = x - y + C$.
8. $\log \frac{y - 1}{y} = e^x + C$.
9. $\log (xy) + \frac{1}{x} - \frac{1}{y} = C$.
10. $\log (x^2y) = y + C$.
11. $\sin y = C(1 - e^x)^3$.

Page 242, §179

1. $\log y = \frac{y}{x} + C$.
2. $3y^3 \log y = x^3 + Cy^3$.
3. $(y + 2x)^3\,(y + x)^2 = C$.
4. $\log y + \sqrt{\frac{x}{y}} = C$.
5. $y + \sqrt{x^2 + y^2} = Cx^2$.
6. $\log x + \sin \frac{y}{x} = C$.
7. $\sin^{-1} \frac{y}{x} = \log x + C$.
8. $\log y + \frac{x}{y} = C$.

Page 344, §180

1. $ye^{x^2} = x + C$.
2. $y = 2(\sin x - 1) + Ce^{-\sin x}$.
3. $y = \tan x - 1 + Ce^{-\tan x}$.
4. $3y(1 + x^2) = 4x^3 + C$.
5. $6y(1 + x)^2 = (1 + x)^6 + C$.
6. $y = ax + C\sqrt{1 - x^2}$.
7. $y = x^n(e^x + C)$.
9. $y = Cx^2e^{\frac{1}{x}} + x^2$.

Page 345, §181

1. $y^{-5} = \frac{5}{2}x^3 + Cx^5$.
2. $y^{-2} = x + \frac{1}{2} + Ce^{2x}$.
3. $49y^3 + 7(x + 1) + 1 = Ce^{7x}$.
4. $y^{-1} + a = C\sqrt{1 - x^2}$.
5. $y^{-\frac{1}{3}} + \frac{3}{7}x^3 = Cx^{\frac{2}{3}}$.
6. $y^{-1} = 1 + \log x + Cx$.
7. $y^3(x + 1)^6 = \frac{3}{10}x^{10} + 2x^9 + \frac{45}{8}x^8 + \frac{60}{7}x^7 + \frac{15}{2}x^6 + \frac{18}{5}x^5 + \frac{3}{4}x^4 + C$.

Page 349, §183

1. $y = C_1e^{3x} + C_2e^{-2x}$.
2. $y = C_1e^{2x} + C_2e^{-x}$.
3. $y = C_1e^{2x} + C_2e^{5x}$.
4. $y = C_1e^{3x} + C_2e^{-4x}$.
5. $y = C_1e^{7x} + C_2$.

Page 350, §184

1. $y = e^{-\frac{3}{2}x}(C_1 + C_2x)$.
2. $y = e^{4x}(C_1 + C_2x)$.
3. $y = C_1 + C_2x$.

Page 351, §185

1. $y = e^{-\frac{3}{2}x}\left[A \cos \frac{\sqrt{11}}{2}x + B \sin \frac{\sqrt{11}}{2}x\right]$.
2. $y = A \cos 3x + B \sin 3x$.
3. $y = A \cos x + B \sin x$.
4. $\theta = A \cos \omega t + B \sin \omega t$.

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